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Reprinted from the ARCHIVES OF OPHTHALMOLOGY, Vol. xxiii., No. 1, 1894.



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THE subject of exophthalmus has been discussed extensively in recent medical literature. The pathological conditions which may produce this deformity are varied. In most cases it results from some encroachment upon the intraorbital space; in a few, the anterior dislocation of the eyeball is due to relaxation from paralysis or injury of the ocular muscles. Among the factors producing encroachment upon the orbital space may be mentioned: enlargement of the intraorbital vascular system, neoplasms, inflammatory products, lymphoid growths,¹ disease of the orbital walls and neighboring cavities, and intraorbital hemorrhage. It is this last-mentioned factor to which we wish to direct attention.

Intraorbital hemorrhage may be traumatic or spontaneous; by spontaneous we mean, not due to an injury from without. Cases under both heads are comparatively rare. Berlin met with but six of the traumatic variety among 35,376 cases of diseases of the eye, and he was able to collect but three indisputable examples of the spontaneous variety in medical literature up to the year 1880.² A fourth case³ he excludes for the reason that the diagnosis was not sufficiently certain.

Von Graefe explains the rarity of spontaneous intraorbital

¹ In leucæmia see Leber, *Graefes Archiv f. Ophthalm.*, vol. xxiv., part I, p. 295; and also Loring *Textbook of Ophthalm.*

² Graefe and Saemisch, *Handbuch der Augenheilk.*, vol. vi., p. 560.

³ Von Graefe, *Arch. f. Ophthalm.*, vol. i., part I, p. 424. We shall refer to this below.

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hemorrhage by the fact that the orbital vessels are under the uniform pressure of the eyeball, which thus mechanically supports them.¹

To Berlin's list of traumatic cases may be added one of Snell,² one of Ullrich,³ one of Galezowski,⁴ one of Pagenstecher,⁵ one of Priestley Smith,⁶ and four cited by Schliephake,⁷ besides one⁸ which we shall presently describe. It must be noted, however, that this list is by no means complete.

This variety of orbital hemorrhage may be due, as Berlin⁸ shows, to a perforating injury or to external violence in which case there is usually a fracture of the bony walls of the orbit. Whether due to direct or indirect trauma there are usually palpebral and conjunctival ecchymoses, together with chemosis. But there is this difference,—that when the trauma is direct the ecchymoses appear immediately; while when it is indirect and fracture of the orbital walls occurs, the conjunctiva and lids may at first show no sign of hemorrhage, but usually the blood appears later and gradually advances toward the cornea; in some cases the lid alone is discolored.

The late appearing sub-conjunctival hemorrhages were formerly considered a classical sign of orbital fracture, especially of the roof, but Berlin has shown that this cannot be absolutely relied upon.⁹ Albert states that they may arise from blood primarily effused into the cranial cavity which subsequently finds its way into the orbit through the optic or anterior lacerate foramen.

The appearance and the degree of exophthalmus, it is

¹ Von Graefe, *Arch. f. Ophthalm.*, vol. i., part I, p. 430.

² *Ophthalmic Rev.*, vol. i., 1812, p. 402.

³ Zehender's *Monatsbl. fuer Augenheilk.*, 1882, p. 242.

⁴ Quoted by Ullrich, *Monatsbl. fuer Augenheilk.*, 1882, p. 246.

⁵ Knapp, *Archiv. of Ophth.*, 1884, p. 22.

⁶ *Royal London Ophthalm. Hospital Reports*, July, 1888. Summarized in Hirschberg's *Centralblatt fuer Augenheilkunde*, 1889, p. 59. This case deserves special mention. It occurred in a hemophilic youth, seventeen years of age, resulting from a blow on the middle of the eyebrow. This is the only case which we have been able to find, in which hæmophilia played any part in the production of exophthalmus.

⁷ Ueber Verletzungen des N. Opt., etc. *Inaug. Diss.*, Giessen, 1888.

⁸ Graefe and Saemisch, vol. vi., p. 560.

⁹ *Diagnostik der chirurg. Krank.*, 4 ed., 1887, p. 51.

almost needless to explain, depend upon the amount and situation of the blood extravasated. If there is a fracture of the orbit communicating with the nasal cavity, the blood may thus escape without producing any protrusion. Again if the amount of effused blood is small, no exophthalmus may occur. Besides the exophthalmus there is usually more or less restriction of the movements of the eyeball, and frequently the vision is greatly diminished or even entirely abolished. The visual impairment may be due to retinal concussion,¹ to the pressure exerted upon the nerve by the extravasated blood,² to stretching³ or tearing of the nerve,⁴ or even to a subsequent descending neuro-retinitis, the result of meningeal inflammation.⁵ The exophthalmus itself does not greatly impair vision, for we frequently see marked cases due to the gradual growth of tumors, in which, excepting the diplopia, there is little visual disturbance.

As an exceedingly rare cause of traumatic hemorrhagic exophthalmus, we may mention delivery of the child—especially instrumental delivery. Thus Philipsen⁶ observed a child delivered with difficulty but without instrumental aid, in which exophthalmus appeared on the second day. Within three months, the tumor, which could be felt behind the eyeball, disappeared, as did also the exophthalmus. Philipsen regarded it as a cephalhæmatoma. In a second case of Redemans⁷ forceps were used. Two hours after labor, the right eye protruded, the exophthalmus became so great that the lids were closed behind the eyeball, and reposition was possible only after the eyeball had supplicated and shrunk. A third case coming under this head is that of Lomer.⁸ There are other published cases of exophthalmus following labor, but they appear to be dislocation of the eyeball by direct violence, and are not pertinent to our subject.⁹

¹ Gowers' *Medical Ophthalmoscopy*, 5 ed., p. 183.

² Pagenstecher, Knapp's *Archives of Ophthalm.*, v. xiii., 1884, p. 22.

³ Gowers, p. 183.

⁴ Capron, Knapp's *Archiv. of Ophthalm.*, vol. xi., p. 335.

⁵ Manz, *Graefe's Archiv f. Ophthalm.*, vol. xii., part I, p. 1.

⁶ *Ann. d'Oculist.*, December, 1891.

⁷ *Ann. d'Oculist.*, xxvii., p. 89.

⁸ *Berlin gynaek. Gesellsch.*, Dec., 1883.

⁹ See Bloch, *Centralbl. f. Augenheilk.*, 1891, p. 134.

We can best describe the clinical history of traumatic orbital hemorrhage by relating the following case, which came under our observation within a few hours after the injury.

CASE I.—T. B., age sixty, white, stone-cutter, July 3, 1890, while chiselling stone, was struck in the left eye by one of the fragments. The vision of this eye was at once lost. There was some bleeding from the lid. At the examination of the eye a few hours later, a small wound was found in the upper lid near the inner canthus; there was slight exophthalmus, which was evidently due to a tense swelling back of and around the eyeball. The tumor could be distinctly felt by the finger, especially above the eye. The lids were swollen to such a degree that the eye was uncovered with difficulty; the conjunctiva was somewhat oedematous, and the pupil dilated. Movements of the eyeball were restricted. The ophthalmoscope revealed an intensely white papilla, the retinal arteries so attenuated that they could scarcely be seen, and the retinal veins filled to their normal size. Vision = 0.

July 4, 1890.—Eye no longer prominent; papilla normal in color. V unchanged.

July 5.—Eyelids have become greatly discolored from palpebral extravasations. The exophthalmus has disappeared and likewise the tense tumor felt behind the eyeball.

July 6.—The movements of the eyeball are normal. The left pupil reacts only when strong light is thrown into the right eye.

July 7.—The ophthalmoscopic picture is unchanged. Slight pressure causes pulsation of both the arteries and veins, showing that the blood pressure is diminished. Amaurosis persists.

July 10.—The color of the left papilla is fairly good; the nasal portion is of a healthy pink color, but the temporal part is pale. There are very slight variations in the calibre of the arteries, which are narrower than they should be. Small pale spots are seen scattered near the nasal side of the papilla, especially along the course of the vessels (colloid). The right eye is normal, excepting a few spots similar to those in the left eye. When seen again in August, 1893, the retinal vessels of the left eye were very narrow, and the papilla atrophic. The spots mentioned above were not noted. V. = 0.

It is not difficult to decide upon the manner in which the blindness occurred in this case. The foreign body was very

small, and struck the upper part of the orbit, passing through the upper lid. It is scarcely conceivable that it could have passed back and directly injured the nerve, and still less, to have fractured the orbital walls around the optic foramen. We are therefore forced to the conclusion that the blindness resulted from the pressure of the extravasated blood upon the optic nerve and the retinal vessels. In this case it must be noted that the amount of hemorrhagic effusion was not very great, for it caused but slight protrusion, and rapidly subsided. The pressure upon the ophthalmic artery produced great attenuation of the retinal arteries and pallor of the papilla, while the subsequent atrophy of the papilla was probably secondary and ascending.

This view receives additional support from the fact that the effusion could be felt as a very tense and resisting tumor which must have exerted great pressure upon its surroundings.

The published cases of traumatic hemorrhagic exophthalmus differ from the case just described in the degree of the exophthalmus, the impairment of mobility and the visual disturbance, but they are essentially similar.

Let us now turn our attention to the spontaneous variety. We have already mentioned the cases cited by Berlin.¹ To these may be added two of Ayres,² two of Sattler,³ one of Magnus (scurvy),⁴ three of Spicer (infants with scurvy rickets),⁵ one of Panas,⁶ one of Jeafferson (whooping-cough),⁷ one of Mitvalsky⁸ (the two mentioned last were blood cysts), one of Day,⁹ and one which we shall now describe¹⁰:

S. B., aged 43, a stout, heavily-built negro. Came to City Hospital Dispensary, May 16, 1892, complaining of gradual failure

¹ *Loc. cit.*

² Knapp's *Archives*, vol. x., 1881, p. 42.

³ Knapp's *Archives*, vol. xiv., 1885, p. 190.

⁴ *Deutsch Med. Wochenschr.*, vol. iv., 1878, p. 29, summarized in Schmidt's *fahrbuecher*, vol. clxxxii., 1879, p. 58.

⁵ Knapp's *Archives*, vol. xxii., 1893, p. 390.

⁶ *Arch. d'Ophthal.*, vol. viii., 2, p. 153, reviewed in Knapp's *Arch.*, vol. xvii., 1888, p. 511.

⁷ *Lancet*, 1889, vol. ii., p. 111.

⁸ Hirschberg's *Centralbl.*, 1893, p. 1.

⁹ *Medical News*, vol. lii., 1888, p. 460 (incomplete history).

¹⁰ Since sending this paper to the publishers we have found another case due to scurvy-rickets; see Railton, *Lancet*, March 3, 1894.

of sight. His previous history was fair. He stated that he had no recollection of having had ordinary diseases of children, or rheumatism, but had had two attacks of smallpox. Admitted having had gonorrhœa a number of years ago. A stricture gradually developed, and with it cystitis. Denied syphilis. Had been much addicted to alcohol and tobacco. He traced his failure of sight to an attack of grippe six months previous. The ophthalmoscopic examination showed that the macular half of the left papilla was pale, the right papilla decidedly atrophic. V, R. E., $\frac{4}{60}$, V, L. E., $\frac{4}{4}$ almost. There was a central scotoma for red in the left eye. In the right eye this color could not be recognized anywhere throughout the field. There was absence of patellar reflex, but there were no signs suggesting tabes dorsalis. The visual trouble was evidently due to a retrobulbar neuritis, and was perhaps the result of the grippe, or more probably owing to the excessive use of tobacco and alcohol, to which he was addicted. Strych. sulph. was ordered, and strict abstinence from alcohol and tobacco was insisted upon. He came from time to time for several months, continuing the use of strychnine, but there was no improvement. It may be mentioned that we had good reason to believe that he did not abstain from either tobacco or alcohol.

Fan. 18, 1893.—He presented himself with very marked exophthalmus of the right eye. He assured us that he had not suffered any injury, and that when he went to bed on the previous night, his eye was in its normal position. After having risen in the morning and washed, he experienced a "shooting" pain in the eye, and felt that the eye protruded. We saw him a few hours afterwards, and found the eye almost out of the orbital socket and somewhat painful. The exophthalmus measured about half an inch, and was almost directly in the visual line. The eyeball could not in the least be forced back into the orbit, the pressure exerted causing pain. The palpebral fissure was very much widened, and the eyelids could not be closed entirely. When they were still further separated, the eyeball seemed to be almost entirely out of the orbit. V, R. E. : Could not count fingers correctly even when held near the eye. Ophth. examination : Papilla very white, arteries and veins narrowed, the picture being the same as above, so far as can be seen. The conjunctiva showed no inflammatory signs. The movements of the eyeball were restricted in all directions. A pressure bandage was applied, and mercurial inunctions and potassium iodide were

ordered. On the following day the pain had entirely subsided, but the exophthalmus remained unchanged. Vision had improved slightly: he could count fingers when held very near. The lower portion of the ocular conjunctiva which was exposed in the palpebral fissure, being unprotected, became reddened and swollen. The rest of the conjunctiva was perfectly normal.

Jan. 20.—The exophthalmus had subsided considerably. Vision the same. The field of vision was almost abolished on the nasal side, and greatly restricted below. He could at this time almost close the eyelids. There was scarcely any sensitiveness to pressure. There was gradual improvement until

Feb. 2, when the exophthalmus had greatly diminished. (There were but 3–5 mm of protrusion.) The conjunctival congestion, which was always limited to that part of the ocular conjunctiva which was exposed, had almost disappeared. There was neither pain nor sensitiveness. The caruncle appeared prominent, and pressure on the eyeball caused it to protrude still farther. When the left eye looked directly forward the palpebral fissure of the right was almost twice as large as that of the left, but the right cornea was not exposed, on account of a high degree of strabismus sursum vergens which had gradually manifested itself. The eye was also somewhat divergent.

Feb. 6.—We could not find any exophthalmus (nineteen days from its first appearance), but there was still strab. diverg. superior. The strabismus gradually disappeared, vision improved a little, and May 9th it was found to be about the same as when examined a year previous. The ophthalmoscopic picture was unchanged, papilla white, and vessels narrow.

At no time during the history of this case was there any blood to be seen under the conjunctiva, though it was looked for from day to day. The eye was frequently examined to detect a bruit, but none could be discovered, nor could any pulsation be felt. The urine contained albumen, but no sugar.

Feb. 27.—We re-examined the patient, and found V, L. E., $\frac{6}{30}$, V, R. E. reduced to seeing movements of the hand at two feet. The field of the left eye had normal limits, but there was a central scotoma (absolute for red) about 14° in breadth and about 10° in height, not reaching to the blind spot. The field of the right eye could not be accurately taken. The limits appeared to be normal, but there was a very large and absolute central scotoma. The appearance of the retina and nerve of both eyes was

unaltered. It was noted that the arteries showed decided variations in their calibre, with slightly hazy borders at certain points—indications of arteriosclerosis.

The general condition remained unchanged. The arteries at the wrist were palpable after blood was forced out, but the temporal arteries were not. There was a blowing systolic murmur heard at the apex, but neither sound was accentuated. The apex beat was 1 cm outside the nipple line in the fifth interspace. The urine was markedly alkaline, with ammoniacal odor, and there was some albumen, but no casts. It contained red and white blood corpuscles (cystitis). Spec. gravity, 1022.

The diagnosis in this case was spontaneous hemorrhage into the orbit. The grounds for this were: First, the *suddenness* of the onset; second, the comparative freedom from pain; third, the absence of any inflammatory signs, of throbbing or of bruit.

It will be seen that the vision of both eyes was greatly diminished. We could not account for this, except as a result of his intemperance. The previous optic nerve trouble complicates the case. The vision of the R. E. was very poor before the exophthalmus developed, but it was evidently diminished to some extent by this occurrence, and remained permanently impaired.

The cause of the hemorrhage into the orbit in this patient seemed to be due to a degenerated condition of the vascular walls, as shown by the thickening of the radial arteries, the position of the cardiac apex, and especially by his personal habits, as mentioned above. The appearance of the retinal arteries furthermore supports this view.

This case presents great similarity to that of v. Graefe.¹ The high degree of amblyopia of the right eye prevented any diplopia, but the muscular paralyses were very similar, even to the strabismus sursum vergens which came on before there was complete recovery. The course was about the same (fourteen days in v. Graefe's case). In that case likewise no blood appeared under the conjunctiva during the entire course. It was for this reason that Berlin excludes

¹ Referred to at the beginning of this paper.

this case, as mentioned above. Nevertheless, we consider that in both cases the diagnosis of orbital hemorrhage is sustained.

A careful review of the three cases cited by Berlin, together with v. Graefe's case and the twelve cases which we have collected (leaving out that of Day because of insufficient data), will show that spontaneous hemorrhagic exophthalmus may occur at any period of life, from infancy to old age. It is usually monocular, but may be binocular (Sattler, two cases), and may be recurrent (Fischer, one, Sattler, one, and Magnus one). It may depend upon a hemorrhagic diathesis (as in three cases cited by Berlin, in Magnus's case of scurvy,¹ and in the three cases of Spicer, or upon arterio-sclerosis (Sattler, two cases, and our own). The onset of the exophthalmus is very sudden (except in the case of Fischer, in which it depended upon frequent but small hemorrhagic effusions, gradually producing exophthalmus). The movements are restricted in most cases. The duration of the exophthalmus, which usually disappears completely, is a few weeks (two to four), but the effusion may persist for a long time. The occurrence of conjunctival ecchymoses, upon which Berlin lays the greatest stress, considering it the critical sign of orbital hemorrhage, varies very much. It is noted in the three cases cited by Berlin, in one of Ayres's, and in one of Sattler's cases, but not in v. Graefe's, in Ayres's second case, in Sattler's first case, in Magnus's (there was suggillation of the upper lids), and in ours. We do not, therefore, consider this sign as absolutely necessary for the diagnosis. The aspirating needle, which was used in several cases (Ullrich, Jeafferson), establishes the certainty of the diagnosis when a quantity of blood is emptied, and the eye then goes back to its proper position.

The rapidity of the onset is not absolutely peculiar to hemorrhages, for an orbital abscess may also make its appearance within a short time. But the latter may be distinguished by the inflammatory symptoms (fever, con-

¹ Berlin refers to the fact that some writers mention the occurrence of orbital hemorrhages in typhus and scurvy, but he was unable to find a single authentic case.

gestion, œdema of the conjunctiva and lids, etc.) which usually accompany it,¹ and the termination in discharge of the pus. Inflammatory symptoms likewise characterize thrombosis of ophthalmic veins. In the case which we have just described, there was never any fever or throbbing pain (the pain was never severe, seemed to be due to the tension of the tumor behind the eye, and soon disappeared).

The rapid onset enables us to distinguish this condition from various tumors which occur in the orbit. The rapid subsidence is characteristic of most cases. In some the course is protracted, and in a few the blood becomes encapsulated, forming a hematocele (Jeafferson, Mitvalsky, and Ullrich; this last was a traumatic case).

According to Wecker,² the seat of intraorbital hemorrhage may be between periosteum and bone, in the fatty tissue of the orbit, or between the eyeball and Tenon's capsule.

In both of our cases there were distinct ophthalmoscopic changes, consisting of pallor of the papilla with narrowing of the vessels. Pagenstecher, in the examination of a similar case, observed white spots which followed the course of the vessels and disappeared on restoration of the circulation, but in none of the other cases of which we have any record were they noted.

The appearance of retinal detachment may be produced, as in the case reported by Ullrich,³ in which the diagnosis of simple detachment was made; so confidently was this diagnosis held that the patient was shown as an example of retinal detachment; the error became apparent on later examination, when an incision was made and the effused blood evacuated, with the disappearance of the pseudo-detachment. In this case the retinal vessels were enlarged and tortuous, the retina cloudy, the limits of the papilla indistinct, and there was projection of the lower portion of the retina into the vitreous.

¹ But not always. V. Graefe recommends an early puncture to ensure the correct diagnosis.

² Graefe and Saemisch, *Handbuch.*, vol. vi., p. 558.

³ Von Graefe and Berlin have also described the appearance of retinal detachment in orbital abscess, which disappeared on emptying the pus (*vide* Ullrich, *loc. cit.*).

While there were distinct ophthalmoscopic changes in both of our cases, this does not always occur, for in three of Berlin's cases, in one of Ayres's, and in Jeafferson's case there were no ophthalmoscopic changes.

The same condition of the vessels which is favorable for post-bulbar hemorrhage would seem to predispose to intra-ocular hemorrhage. Thus, in the case of Sattler, the orbital hemorrhage was complicated by hemorrhagic retinitis. In some of these cases one would anticipate cerebral hemorrhage,¹ but we have no note of such an accident in any of our series.

The tolerance with which some eyes bear hemorrhagic effusions is remarkable; in Jeafferson's case, vision was unaffected, though the exophthalmus had lasted five months.

Besides the direct effects of the injury which occur in traumatic cases, vision may be further affected; the effusion, by pressing on the optic nerve, may mechanically interfere with its circulation, while pressure on the nerves (3-4-6) supplying ocular muscles may cause restriction of motion with its sequence, diplopia, and mydriasis may occur. Vertical pressure on the eyeball itself may cause elongation, with consequent myopia; this was well seen in Ullrich's case, where a myopia of 6 D at the macula disappeared on evacuating the effusion. The opposite condition, hypermetropia, may also be produced in a similar manner.²

We need add little concerning the treatment. In our cases, the application of cold and a compress bandage was mainly relied upon. Some authors advise the use of the trocar (v. Graefe, Jeafferson), others make a free incision, and these procedures are undoubtedly necessary in those cases in which the blood becomes encysted. Panas, however, considers it inadvisable to operate, because of the liability to recurrence.

¹ Gowers's *Med. Ophthalmoscopy*, third edition, p. 40.

² Pagenstecher, *Knapp's Archives*, vol. xiii., 1884, p. 22.



The Knickerbocker Press

G. P. PUTNAM'S SONS

NEW YORK